Area 317 South – Chronological Photos

Phytoremediation Project

Argonne 317/319 Area

Second Annual Status Report – 2001

Submitted By:

Applied Natural Sciences, Inc.

Hamilton, Ohio 45011

Applied Natural Sciences

Applied Natural Sciences, Inc
4129 Tonya Trail
Hamilton, Ohio 45011
Ph: 513-895-6061
Fax: 513-895-6062
email: ans@fuse.net

February 5, 2002

Argonne National Laboratory
9700 South Cass Avenue
Argonne, Illinois 60439

Attn: James Wozniak

Re: Fall 2001 Site Activity Report

Dear Jim,

This letter is being provided to document Applied Natural Sciences, Inc. (ANS) results and recommendations from the Fall 2001 site visit for the 317/319 Phytoremediation Project. The Fall 2001 examination was conducted November 22-24, 2001, and involved the evaluation of tree height and growth conditions for designated areas.

SUMMARY

The attached site map provides data on tree height and vigor (see rating system described below) for each tree within the distinct areas of the site. Averages for each delineated area and each row within that area markedly increased in both tree height and tree vigor from the Fall 2000 evaluation. These averages suggest that for the most part, tree vigor was Good and continuing to improve, and tree height increased from between 6 and 7 feet in 2000 to between 8 and 12 feet in 2001. This translates into an average increase of 3.49 feet, 5.42 feet and 3.88 feet for the 317, 319 East and 319 West areas, respectively.

A notable exception in average tree vigor was found for the shallow-rooted trees in the 317 South Area (not part of the groundwater remediation program). These trees continue to be rated lower in vigor and may reflect the condition of late initial planting and replanting of many of these trees during the Spring, 2000 and 2001. Although the vigor rating for these trees remained lower than the phytoremediation trees, it did show improvement compared to the Fall 2000 statistics.

Data were not collected for the French Drain and Waste Trench Areas during the Fall 2001 and are therefore not reported. The French Drain Area trees are being closely monitored for height and other parameters by Cristina Negri. Many of the Waste Trench Area trees have been damaged by deer and the elements making year to year comparisons somewhat inconclusive. However, these trees are continuing to grow and will be evaluated during the Fall 2002 monitoring activity for comparison to the Fall 2000 data.

In general, tree growth and tree vigor values are extremely encouraging. The 2001 growing season more typically reflected climatic and growth conditions for this area. This, in turn, likely accounts for increased tree height and increased tree vigor ratings across the site. These data correspond to expected height and vigor values based on

predicted growing conditions. The 2001 growing conditions differ, however, from 2000 growing conditions in which cooler temperatures and lower Growing Degree Day (GDD) values were realized for the April through July portion of the growing season (see Table 1 and discussion in the Appendix - 2000 Growing Conditions and Effects).

BACKGROUND

The 317/319 Phytoremediation Project was planted late in the spring and early summer of 1999. Hybrid poplar trees were planted to hydraulically mitigate groundwater flow and remove a number of volatile organic compounds, including trichloroethylene, 1,1,1-trichloroethane, and 1,1-dichloroethane, and tritium in the groundwater of the deeper aquifer located 25 - 30 feet below ground surface. ANS employed its patented *TreeWell*™ system to overcome the problem of a shallower uncontaminated perched aquifer (located 10-12 feet below ground surface). With the *TreeWell*™ system, rainwater and the shallow aquifer are sealed off from poplar tree's root system (see Attachments - Figure 1). Ultimately, the trees are able to use only the deep groundwater and thus effect the contaminant removal and hydraulic mitigation required.

RESULTS

2001 Growing Conditions

Argonne realized more typical climatic conditions for the 2001 Growing Season. Early growing conditions were much more favorable than in 2000 and this is reflected in increased tree growth and tree vigor across the site. Growing degree day (GDD) values were averaged over a three year period and used in comparison of 2001 GDD values. These results are presented in the table below.

Table 1. Growing Degree Day Data

Growing Degree Day* Period	1999 GDD	2000 GDD	2001 GDD	(1999-2001) 3 Year Average GDD
April 16 - July 31	1880	1586**	1726	1731
August 1 – November 30	1259	1409	1309	1326
Growing Season	3139	2995	3035	3056

- *- Growing Degree Days are calculated by cumulatively adding the value of the average daily temperature (ADT) that is greater than 50F (i.e. if ADT>50 then ADT-50 for a given day is cumulatively added to a running total for the growing season). GDD is used as an indicator parameter for vegetative growth potential in a climatic zone.*
- *** Very low GDD during the important first half of the growing season*

A comparison of the growing conditions (measured in GDDs) between the 2000 and 2001 season is notable. The early 2000 growing conditions were poor for this climatic zone which resulted in reduced growth and lower vigor ratings (See Appendix, 2000 Growing Conditions and Effects). The 2001 GDD values were more typical for this area. A distinct difference was seen during the growing period of April 16- July 31. The number of GDDs increased by 9% during this period and results are conclusive. Thus, 2001 GDD values coincided more closely with typical climatic conditions, therefore leading to increased vegetative growth and continued increases in tree height and tree vigor values.

Fall 2001 Visit

During the Fall-2001 visit, trees were evaluated for tree growth and vitality. Tree height was measured and a ranking system was used to describe the overall growth and vigor of each tree. This ranking system employs a subjective zero to five scale that is qualified as follows:

0 = dead 1=poor, 2=fair 3=good 4=very good 5=excellent

From this scale, a tree that ranked below 2 may be a candidate for future replacement while a ranking of 4 or above suggested that the tree was growing vigorously and in a manner expected during optimum conditions.

317/319 Areas

The poplar trees in the 317/319 area are divided into two groups; shallow-rooted and deep rooted. The shallow-rooted were planted like normal landscape trees where the roots are permitted to develop in the vadose zone of the upper horizons of soil. The deep-rooted trees were planted in the *TreeWell* holes to direct roots downward to intercept the deep groundwater.

The shallow-rooted poplars and deep-rooted trees grew similarly in height. The shallow-rooted trees averaged 8.2 feet in height while the deep-rooted trees averaged about 10.2 feet in height (see Table 2 and Appendix – Spreadsheet Maps). A notable exception was found in the 319-East area where the average height was 12.7 feet (these trees were planted slightly shallower which may account for their greater height).

Average increases in height for the 317 area compared to the 2000 were higher for the deep-rooted trees (+3.49 ft.) than the shallow-rooted poplars (+1.13 ft). For the 319 West area the increase were 3.88 and 4.30 for deep and shallow rooted trees, respectively. One apparent reason for the comparable height of the shallow and deep rooted trees in the 319 area compared to the 317 area is the better drained soil of the 319 area. The lower, poorly drained soils, of the 317 area have caused many of the shallow rooted trees to become stunted and die effecting an overall reduced tree height and vigor for many of these trees.

The Fall 2001 vigor rating (see Table 2) on the other hand was higher for the deep-rooted trees where the average was about 3.4 (Good to Very Good) compared to the average 2.6 (Fair to Good) for the shallow-rooted trees in the 317 area. Increases in vigor for 2001 were comparable for both shallow and deep trees. Unfortunately, the shallow-rooted trees remain behind the deep-rooted trees in the 317 area. This is likely a reflection of the poorly drained soils of the west end of the 317 area.

Table 2. Tree Height & Vigor by Area for 2001

Tree Planting Method Areas	Height Deep (feet)	Height Shallow (feet)	Vigor Deep (feet)	Vigor Shallow (feet)
317	10.2	8.2	3.4	2.6
319 East	12.7	na	3.9	na
319 West	10.0	11.2	3.3	3.3

The shallow-rooted poplars were planted with the root crown near ground surface versus several feet below ground surface for the deep-rooted trees. The deep-rooted trees were predominantly HP-308 (P.Charkowiensis x P.Incrassata) and the shallow-rooted trees were predominantly HP510 (P.Maximowiczii x P.Trichocarpa). Based on the Fall 2000 and Fall 2001 statistics, the deep-rooted trees are growing at a faster rate than their shallow-rooted colleagues, and have surpassed the shallow-rooted poplars to a higher average height. The deep-rooted trees are also ranked consistently better with respect to their vigor. Consequently, it appears that the deep-rooted trees are responding more favorably to the growing conditions.

CONCLUSIONS

Tree height and vigor

Both tree height and vigor values increased from the Fall 2000 visit. These increased values were a result of more typical climatic conditions and growth potential was thus realized. Increased tree height and vigor is expected throughout upcoming seasons, provided continued hospitable growing conditions and adherence to recommendations.

Rooting Depth

TreeWell or deep-rooted trees will be expected to root to a depth of 20 or more feet to encounter the capillary fringe of the deep aquifer. Based on average root growth rates observed in root activity studies and root development empirically observed at other *TreeWell* sites, root development for the deep-rooted trees should generally 15 feet below

ground surface. When the roots do reach the capillary fringe of the groundwater, it is typically evidenced by the changes in the morphology of the apical leaves. They become significantly larger than the other leaves on the trees (2-4 times as large) which apparently reflects the luxury consumption of water by the trees.

Intended rooting depth of the Waste Trench willow trees and the shallow-rooted poplars is 0 to 5 feet below ground surface. French Drain willows will be expected to achieve rooting activity to approximately 20 feet below ground surface (or the extent of the soil mixing depth). Deeper rooting by the French Drain willows should occur over a much longer time period due to the dewatering required of the mixed soil.

RECOMMENDATIONS

Expectations for growth and development of the trees in 2002 are generally very good provided continued typical climatic parameters are realized. Mowing and other weed control measures should continue to be performed. Holes should be backfilled with approximately one-half yard of sand or gravel per hole. Correspondingly, tree-mound rebuilding will be necessary to maintain the integrity of the *TreeWell* system. Tissue sampling, root development and growth measurements should be re-evaluated towards the end of the 2002 growing season for comparison with the 2001 data. Rooting depth evaluations should be accomplished in the early fall to evaluate root development rates.

Another consideration should be the creation of a rainfall "cap" on the French Drain. This "cap" could be cheaply created by developing a basin between the rows of trees and lining the basin with plastic and drainage tile to promote the runoff of rainfall water. Reducing rainfall water in this system would promote deeper rooting development and more aggressive decontamination of the soil.

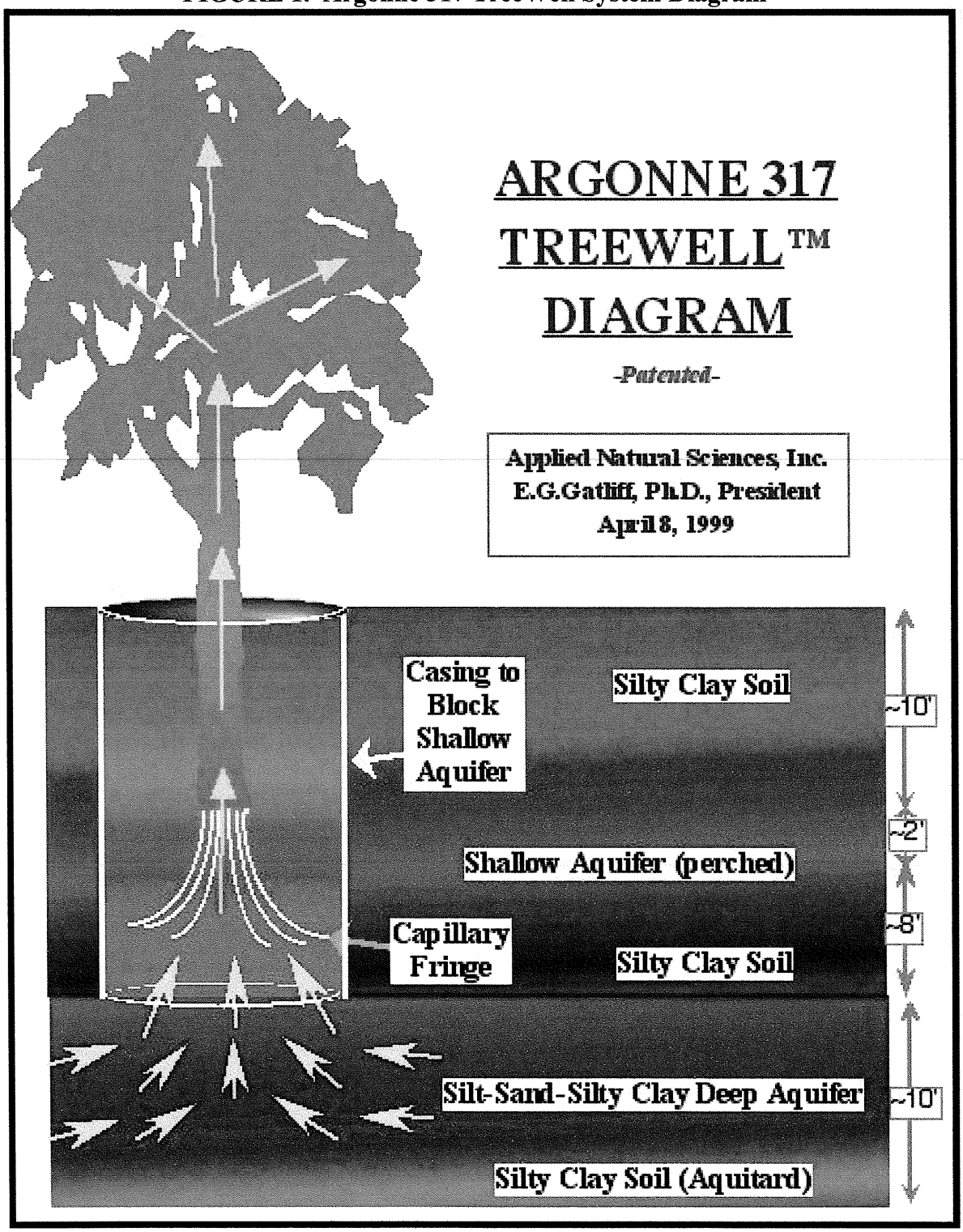
Should you have any other questions regarding this submittal, please do not hesitate to contact me.

Sincerely,
Applied Natural Sciences, Inc.

Edward G. Gatliff, Ph.D.
President

Attachments:

FIGURE 1. Argonne 317 TreeWell System Diagram



APPENDIX

Abridged Version of Fall, 2000 Report

2000 Growing Conditions and Effects

In general, the growth and vigor of the trees are about as good as could be expected considering the late 1999 planting and the cooler than normal growing conditions realized in 2000 (see Growing Degree Day data below). To help qualify the effect of the cooler growing conditions, Argonne growth and vigor data were compared data derived from another ANS *TreeWell™* site. At the *TreeWell* site in Staten Island, New York, tree vigor was generally Very Good and tree height averaged between 9 and 10 feet at the same stage of development (~~see Attachments - Pictures 1 and 2~~). Based on this comparison and years of observation of similar phytoremediation systems, it is almost certain that the growth limiting conditions at Argonne, described below, adversely affected the height and vigor of these trees for the 2000 growing season.

Tree Height and Vigor

The 2000 GDD values correlate closely with what was observed in the field. That is, vegetative growth through July, 2000 was observably limited while growth from August through October was markedly positive. In fact, most of the visual growth that occurred during the 2000 growing season took place after July 31st. Accordingly, based on these observations and experience at other sites, we can conclude with some certainty that under more normal growing conditions we would expect better growth and vigor from the trees than were realized in 2000.

Cool Growing Season Effects – Nutrient Status

One additional perspective worth mentioning is the effect that cooler growing conditions had on tree appearance during the 2000 growing season. The primary effect of the cooler growing season relates to overall appearance of the plant. It is also common for plants growing in cooler than normal conditions to reflect nutrient deficiencies. These are not actual deficiencies that result from low soil nutrient status (as soil nutrient status was addressed at planting time and is quite adequate) but merely a reflection of the plant's metabolic imbalances. Apparent nutrient deficiencies, that aren't reflecting soil nutrient status, may be caused by:

1)temperature limited respiration,
2)temperature limited photosynthesis,
3)temperature limited root development,
4)temperature limited nutrient translocation from the root to the shoot,
5)temperature limited translocation of nutrition to the roots,
6)other related conditions, or
7)a combination of one or more of these items.

Cool Growing Season Effects –Pathogen Status

The second effect of this cooler growing season was the regional impact that the pathogen, fungal rust, had on poplar trees throughout the midwest. The rust was characterized by pin-head sized orange red bumps uniformly dispersed on the tops of the leaves. The damage to the plant is limited to the early loss of leaves and does not automatically carry over to the next growing season. Long before the rust spores appear on the leaves, some leaves turn yellow and fall from the tree giving the overall appearance of a poplar tree either undergoing drought conditions or having a nutrient deficiency (~~see Attachments – Pictures 1,3 and 4~~). These conditions were observed from eastern and southern Ohio to northern Illinois and southern Michigan in 2000.

SPREADSHEET MAPS

Row	Tree Ct	Shallow	TreeWell		% change from Fall 2000 data Shallow	% change from Fall 2000 data TreeWell	change from Fall 2000 data Shallow	change from Fall 2000 data TreeWell
L	15							
		9.3	9.7		12%	48%	1.03	3.15
		2.2	3.0		10%	9%	0.20	0.24
M	17							
		7.4	9.7		18%	41%	1.13	2.81
		2.4	3.2		0%	-1%	0.00	-0.02
N	15							
		6.5	12.4		-12%	75%	-0.88	5.32
		2.1	3.9		42%	21%	0.63	0.68
O	15							
		8.6	11.1		2%	68%	0.20	4.50
		2.4	3.7		33%	22%	0.60	0.67
P	17							
		8.2	11.4		-6%	80%	-0.50	5.07
		2.7	3.7		33%	22%	0.67	0.66
Q	17							
		7.5	10.4		-13%	64%	-1.17	4.07
		2.3	3.4		56%	16%	0.83	0.46
R	17							
			10.5			60%	0.00	3.91
			3.3			11%	0.00	0.32
S	27							
		7.3	10.1		2%	49%	0.17	3.30
		3.0	3.8		57%	21%	1.08	0.66
T	21							
		7.7	10.7		109%	45%	4.00	3.33
		3.3	3.8		82%	22%	1.50	0.69
U	19							
		10.1	9.4		44%	57%	3.10	3.43
		3.0	3.4		25%	21%	0.60	0.58
V	23							
		7.8	8.9		15%	32%	1.00	2.18
		2.3	2.8		27%	8%	0.50	0.21
W	23							
		7.0	9.6		84%	49%	3.20	3.15
		2.8	3.1		25%	3%	0.55	0.09
X	23							
		9.5	9.1		32%	29%	2.30	2.04
		2.8	3.0		-8%	-2%	-0.25	-0.07
y	21							
		7.4	8.7		0%	48%	0.03	2.80
		2.3	2.9		15%	5%	0.30	0.13
Z	24							
		9.2	10.3		22%	39%	1.67	2.89
		2.8	3.4		22%	22%	0.50	0.61
AA	22							
		8.4	11.2		34%	54%	2.15	3.92
		3.0	3.4		44%	8%	0.92	0.25
BB	25							
		8.8	10.7		7%	51%	0.58	3.61
		2.8	3.5		70%	26%	1.17	0.72
CC	26							
		8.1	10.2		24%	48%	1.57	3.32
		2.8	3.3	Average	54%	15%	0.97	0.42
Total	**367**	**8.2**	**10.2**	**Height**	**16%**	**52%**	**1.13**	**3.49**
Trees		**2.6**	**3.4**	**Vigor**	**29%**	**15%**	**0.59**	**0.44**
		shallow	TreeWell		shallow	TreeWell		

Fall 2001 | **317** | **South** | ***-Pg* 1 of 3**

-40	-32	-24	-16	-8	0	8	16	24	32	40	48	56
TreeWell	Shallow				Aug-99		Jun-01		Aug-99		Aug-99	
Planted	Planted				12.5		8.0 R		9.0		8.0	
Replanted	May-00				3.0		2.0		2.0		1.5	
Replanted	Jun-01					May-00		May-00		Aug-99		Jun-01
						8.0		10.0		4.0		7.5
						3.0		2.5		2.0		2.0
					MW		Aug-99		Aug-99		Aug-99	
							5.0		7.0		6.0	
							2.0		2.0		2.0	
						Jun-01		Aug-99		Aug-99		Aug-99
						8.0		10.0		9.0		9.0
						2.5		3.0		2.0		3.0
					Aug-99		Aug-99		Aug-99		Jun-99	
					8.0		7.5		9.0		11.5	
					2.5		2.5		3.0		3.5	
						Aug-99		Aug-99		Aug-99		Jun-99
						6.0		10.0		6.5		13.5
						1.5		3.0		2.5		3.5
					Jun-99		Jun-99		Jun-99		Jun-99	
					11.0		11.5		8.0		7.5	
					3.0		3.5		3.5		2.5	
	Jul-99				Jun-99	Aug-99	Jun-99	Aug-99	Jun-99	Aug-99	Jun-99	Aug-99
	8.0				13.0	8.5	11.0	9.5	10.5	5.0	9.0	4.0
	3.0				4.0	3.0	4.0	3.0	4.0	2.5	4.0	2.5
	Jun-01				Jun-99	Ref@1'	Jun-99	Ref@1'	Jun-99	Aug-99	Jun-99	Aug-99
	na				14.0		14.5		4.0	6.0	10.0	na
					5.0		5.0		2.0	3.0	3.5	
		Jul-99				Jun-99	May-00	Jun-01	Aug-99	Jun-99	Aug-99	Jun-99
		7.0				8.5	11.0	na	8.0	11.0	14.0	11.0
		3.0				2.5	3.0		2.0	4.5	4.5	3.5
	Jun-01			May-00	Jul-99		Jul-99	Aug-99	May-00	Aug-99	Jun-99	Jun-01
	8.0			9.0	12.5		11.5	8.0	12.0	11.0	8.0	8.0
	1.5			2.0	4.0		3.0	3.0	3.0	3.5	3.0	2.0
	Jul-99						Aug-99	Jul-99	Aug-99	Jul-99	Aug-99	Jun-01
	9.0						4.0	4.0	10.5	9.0	7.5	8.0
	3.0						2.0	2.0	3.5	3.5	3.5	2.0
		May-00					Jul-99	Aug-99	Jul-99	May-00	Jul-99	Aug-99
		8.0					7.0	8.0	9.5	10.0	9.0	11.5
		2.5					2.0	2.0	2.5	3.0	3.0	3.5
	Jul-99	Jun-01	tree	tree	tree	tree	Ref@2'	Jul-99	May-00	Jul-99	Aug-99	Jul-99
		7.0						11.0	9.5	11.0	12.5	8.5
		2.0						3.0	2.5	2.5	3.5	2.5
		Jul-99		Jun-01		No Tree	Jul-99	Aug-99	Jul-99	Jun-01	Jul-99	Aug-99
		11.5		8.0			4.0	8.0	10.0	7.0	11.0	13.0
		4.0		2.0			2.0	2.5	3.0	2.0	3.0	3.5
Jul-99	No Tree	Jul-99	Aug-99	Jul-99	Jun-01	Jul-99	Aug-99	Jul-99	Aug-99	May-00	Aug-99	Jun-99
11.0		10.0	7.0	11.0	na	10.5	11.0	7.5	9.0	10.0	10.0	na
2.5		3.5	3.0	3.5		3.0	3.5	3.0	3.0	3.5	3.0	
	Jul-99	Aug-99	Jun-01	Jun-01	Jul-99	Jun-01	Jul-99	Aug-99	Jul-99	Aug-99	Jul-99	Aug-99
	9.0	10.5	na	7.0	8.0	na	9.0	6.5	8.0	6.5	8.0	10.0
	3.5	3.5		2.0	3.5		3.0	3.0	2.5	2.5	3.5	3.0
Jul-99	Aug-99	Jul-99	Jun-01	Jul-99	Aug-99	Jul-99	Jun-01	Jul-99	Aug-99	Jul-99	Aug-99	May-00
12.0	8.5	10.0	5.5	11.5	8.5	12.5	na	14.0	7.0	12.0	8.0	11.0
3.5	2.5	3.5	2.0	3.5	3.0	3.5		3.5	2.5	3.5	3.0	3.5

Average Height Increase

Average Vigor Increase

Fall 2001 | **317** | **South** | ***-Pg* 2 of 3**

Row	64	72	80	88	96	104	112	120	128	136	144	152	160	168	176	184	192	200
L	May-00		Jun-99		Jun-99		Jul-99		May-00		May-00		May-00		Jul-99		Jul-99	
	9.0		10.0		14.0		7.5		10.5		11.0		10.0		5.0		8.0	
	2.5		3.0		4.0		3.1		3.0		3.1		3.1		2.0		2.5	
M		Jun-99		Jun-99		Jul-99		Jul-99		May-00		Jul-99		Jul-99		Jul-99		Jul-99
		9.0		10.5		9.5		8.0		10.0		11.0		8.0		8.5		7.5
		3.0		3.1		3.1		3.1		3.1		3.1		3.1		3.0		2.5
N	May-00		Jun-99		Jun-99		Jun-99		May-00		Jun-99		Jun-99		Jun-99		Jul-99	
	8.0		11.0		12.5		14.0		13.0		13.0		15.0		7.5		14.0	
	2.5		3.5		3.5		4.0		3.5		4.0		4.5		3.0		4.5	
O		Aug-99		May-00		Jun-99		Jun-99		Jun-99		Jun-99		Jun-99		Jun-99		Jul-99
		7.0	MW	14.0		7.5		8.5		11.0		9.0		12.0		11.0		16.0
		1.5		4.0		2.5		3.1		3.5		3.5		3.5		4.0		5.0
P	Jun-99		Jun-99		Jun-99		Jun-99		Jun-99		Jun-99		Jun-99		Jun-99		Jun-99	
	17.0		9.5		16.0		11.0		6.5		9.0		11.5		11.0		12.5	
	5.0		3.1		4.5		3.5		3.0		3.1		3.5		4.0		4.0	
Q		Jun-99		Jun-99		May-00		Jun-99		Jun-99		Jun-99		Jun-99		Jun-99		May-00
		10.5		9.0		14.0		6.0		9.0		8.0		10.0		11.0		16.5
		3.5		3.1		4.0		2.5		3.1		2.5		3.5		3.5		5.0
R	Jun-99		Jun-99		Jun-99		Jun-99		Jun-99		Jun-99		Jun-99		Jun-99		Jun-99	
	13.5		11.0		11.5		9.0		13.0		7.5		10.5		11.0		11.5	
	4.0		3.5		3.5		2.5		3.5		3.1		3.1		3.1		3.5	
S	Jun-99	Aug-99	Jun-99	Aug-99	Jun-99		Jun-99	MW	Jun-99		Jun-99		Jun-99		Jun-99		Jun-99	
	8.5	8.5	11.0	8.5	9.0		7.0		11.0		13.0		9.0		11.5		10.5	
	3.5	4.0	4.0	3.0	3.5		3.5		4.0		4.0		4.0		4.0		4.0	
T	Jun-99	May-00	Jun-99	Aug-99	Jun-99	NewMW	Jun-99		Jun-99		Jun-99		May-00		Jun-99		Jun-99	
	10.0	11.0	10.5	6.0	14.0		11.0		12.0		9.0		12.0		9.0		10.0	
	3.5	4.0	4.0	3.0	5.0		3.5		4.0		4.0		4.0		3.5		4.0	
U	Jun-01	Jun-99	Aug-99	Jun-99	Aug-99	Jun-99		Jun-99		Jun-99		Jun-99		Jun-99		Jun-99		May-00
	na	10.0	8.0	11.0	9.5	6.0		na		6.0		7.5		9.5		10.0		11.5
		4.5	2.5	3.5	3.0	2.5				2.0		3.0		3.5		3.5		3.5
V	Jun-99	Aug-99	Jun-99	Aug-99	Jun-99	Tree			Jun-99		Jun-99	MW	Jun-99		Jun-99	MW	Jun-99	
	11.0	4.0	8.0	6.5	10.0				6.0		6.0		8.5		5.0		8.0	
	3.0	1.5	2.5	2.0	2.5				2.0		2.5		3.0		2.0		3.0	
W	Jun-01	Jun-99	Aug-99	May-00	Jun-01	Jun-99		Jun-99		May-00		May-00		May-00		Jun-99		Jun-99
	3.0	15.0	8.0	8.0	na	6.0		7.0		8.0		12.0		13.0		14.5		10.5
	2.0	4.0	2.5	2.5		2.5		2.5		2.5		2.5		3.5		4.0		4.0
X	Jun-99	Aug-99	Jun-99	Aug-99	Jun-99		Jun-99		May-00		Jun-99		May-00		Jun-99		May-00	
	9.0	11.5	11.0	8.0	11.5		9.0		7.0		11.0		7.0		10.0		14.0	
	2.5	3.0	3.5	2.5	3.5		3.5		2.5		3.5		2.0		3.0		4.0	
y	Aug-99	Jul-99	MW	Jul-99	Aug-99	Jun-01		Jun-99		Jun-99	<sunken	Jun-99		Jun-99		Jun-99		Jun-99
	6.0	10.5		9.5	2.0	5.0		5.0		6.0		13.0		13.0		11.5		12.0
	2.0	3.5		3.0	1.5	2.0		2.0		2.5		4.0		4.0		3.5		3.5
Z	Jul-99	Aug-99	Jul-99	May-00	Jun-99	AirStrippr	Jun-99		Jun-99		Jun-99		May-00		May-00		Jun-01	
	13.0	9.0	14.0	10.0	11.0		14.0		13.0		12.0		11.0		10.0		2.0	
	4.0	3.0	4.5	3.5	3.5		4.5		4.0		3.5		3.5		3.0		2.0	
AA	Jun-01	Jun-99	Aug-99	May-00		Pole		Jun-99		Jun-99		Jun-99		Jun-99		Sep-00		Jun-99
	na	15.5	5.0	10.0		MW		9.5		14.0		15.0		10.5		9.0		10.0
		5.0	2.5	2.5				2.5		4.0		4.5		3.5		2.5		3.0
BB	Jun-99	May-00	Jun-99	Jun-01	Jun-99		Jun-99		Jun-99		Jun-99		May-00		Jun-99		Jun-99	
	16.0	12.0	10.5	na	8.0		16.0		14.0		13.0		12.5		14.0		11.5	
	4.5	3.0	3.0		3.0		4.5		4.0		4.0		3.5		4.0		3.5	
CC	Jun-01	Jun-99	Aug-99	Jun-99	Aug-99	Jun-99		Jun-99		Jun-99		Jun-99		Jun-99		Jun-99		Jun-99
	na	14.0	9.0	8.0	10.0	9.0		5.0		11.0		9.0		8.5		6.5		12.0
		4.0	3.0	3.0	3.5	2.5		3.0		3.5		3.0		3.5		3.0		3.5
Total Trees																		

Fall 2001 | **317** | **South** | *-Pg* **3 of 3**

Row	208	216	224	232	240	248	256	264	272	280	288	296	304	312	320
L	Jul-99		May-00												
	11.0		10.0												
	3.5		3.1												
M		Jul-99		Jul-99		May-00		May-00							
		9.5		13.0		10.5		11.0							
		3.5		4.0		3.1		3.5							
N	Jul-99		Control		May-00		Jun-99								
	14.5				12.0		10.0								
	4.0				4.5		3.5								
O	MW	Control		Control		Jun-99		Jun-99							
						14.0		8.0							
						4.5		3.1							
P	Jun-99		Jun-99		Jun-99		Jun-99								
	14.0		7.5		13.0		9.5								
	4.5		3.1		4.0		3.1								
Q		Jun-99		Jun-99		Jun-99		Jun-99							
		11.5		10.0	Bad	6.5		10.0							
		3.5		3.5	Base	3.1		3.1							
R	Jun-99		Jun-99		Jun-99		Jun-99								
	11.0		10.5		11.0		9.0								
	3.5		3.5		3.5		3.1								
S	Jun-99		Jun-99		Jun-99		Jun-99		Ditch		Jul-99	MW	Jul-99		Jun-01
	13.0		13.0		13.0		10.0				7.5		7.0		6.0
	4.5		4.5		4.5		4.0				3.0		3.0		2.5
T	May-00		Jun-99		Jun-99		Jun-99		Ditch		Jun-01	MW			
	12.0		8.0		10.0		15.0				8.0				
	4.0		3.0		3.0		5.0				3.0				
U		May-00		Jun-99					Ditch						
		12.0		11.0											
		3.5		4.0											
V	Jun-99		Jun-99		Jul-99		May-00								
	11.0		8.0		5.0		13.0								
	3.5		3.0		2.0		3.5								
W		Jun-99		Jun-99		Jul-99		Jul-99		Jul-99					
		14.5		9.0		10.0		7.0		8.0					
		4.0		3.5		3.5		3.0		3.0					
X	Jun-99		Jul-99		Jul-99		Jul-99		Jul-99						
	15.0		11.5		1.0	Yellow	7.0		6.0	MW					
	4.5		3.5			Leaves	2.5		2.5						
y		Jun-99		Jul-99		Jun-01		Jul-99							
		8.5		7.0		3.0		4.0							
		3.0		3.0		2.5		2.5							
Z	May-00		May-00		Jul-99		Jul-99		Jul-99						
	16.0		11.5		6.0		7.0		9.0						
	4.5		3.5		2.5		3.5		3.5						
AA		Jun-99		Jun-01		Jul-99		Jul-99							
		11.0		na		17.0		9.0							
		3.5				4.0		3.5							
BB	May-00	MW	Jul-99		Jul-99		Jul-99		Jul-99						
	13.0		9.5		6.0		12.5		5.0						
	3.5		3.0		3.0		3.5		3.0						
CC		May-00		Tree		Jul-99		Jul-99							
		11.5				8.5		8.0							
		3.5				3.0		3.0							
Total Trees															

Fall 2001	319	West	-Pg 1 of 2

Row	360	368	376	384	392	400	408	416	424

TreeWell Planted	Shallow Planted
Replanted	May-00
Replanted	Jun-01

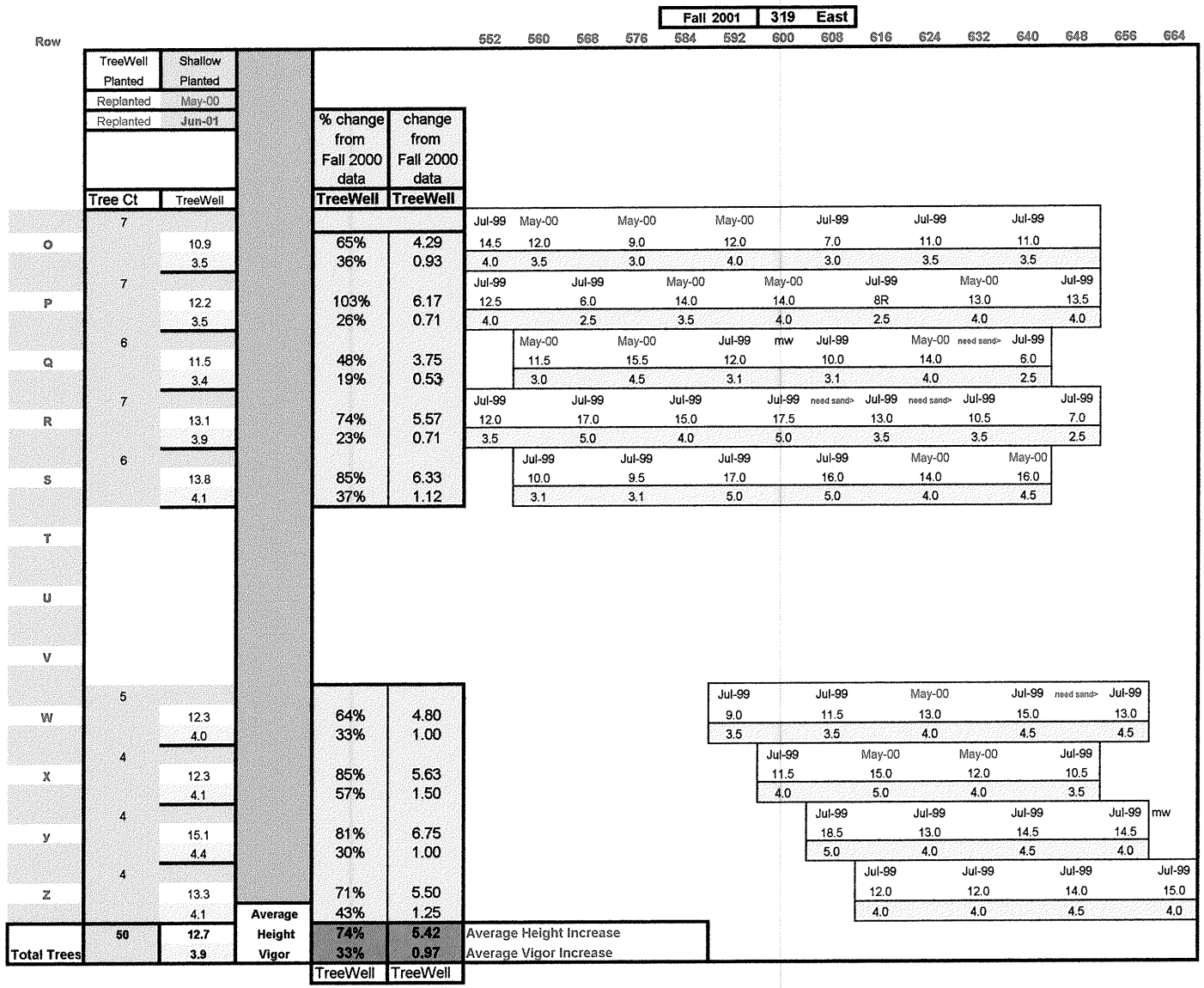
	Tree Ct	Shallow	TreeWell		% change from Fall 2000 data Shallow	% change from Fall 2000 data TreeWell	change from Fall 2000 data Shallow	change from Fall 2000 data TreeWell
	4							
O			8.5			70%		3.50
			3.4			17%		0.50
	7							
P			10.7			47%		3.43
			3.6			9%		0.29
	8							
Q			12.5			64%		4.89
			3.8			27%		0.81
	9							
R		13.0	11.6		117%	65%	7.00	4.56
		4.0	3.5		33%	14%	1.00	0.44
	10							
S			10.3			62%		3.95
			3.5			19%		0.56
	10							
T		10.9			55%		3.85	0.00
		3.4			46%		1.05	0.00
	11							
U		11.5			63%		4.45	0.00
		3.1			30%		0.73	0.00
	10							
V		10.1			52%		3.68	0.00
		2.8			27%		0.60	0.00
	10							
W			10.1			95%		5.16
			3.4			56%		1.20
	10							
X			10.6			56%		3.80
			3.3			33%		0.82
	10							
y			8.7			64%		3.38
			2.9			28%		0.63
	10							
Z		10.5	7.3		31%	44%	2.50	2.23
		3.0	2.6	Average	20%	18%	0.50	0.41
	109	11.2	10.0	Height	61%	63%	4.30	3.88
Total Trees		3.3	3.3	Vigor	31%	23%	0.78	0.63
		Shallow	TreeWell		Shallow	TreeWell	Shallow	TreeWell

Average Height Increase

Average Vigor Increase

									Jul-99
					TREE				9.0
									3.5
				Jul-99		Jul-99		Jul-99	
				16.0		8.0		8.5	
				5.0		3.0		3.0	
			Jul-99		May-00		Jul-99		Jul-99
			11.5		15.0		17.0		8.5
			3.5		4.0		5.0		3.0
		May-00		Jul-99		Jul-99		Jul-99	
		13.0		12.5		14.0		14.0	
		4.0		4.0		4.0		4.0	
Jul-99			Jul-99		Jul-99		Jul-99		Jul-99
13.0			13.0		11.5		8.0		8.5
4.0			4.0		3.5		3.1		3.0
		Aug-99		Aug-99		Aug-99		May-00	
		9.0		7.0		10.0		14.0	
		3.0		2.5		3.0		3.5	
Aug-99			May-00		Aug-99		Aug-99		Jun-01
13.5			13.0		9.5		6.0		8.0
3.5			4.0		2.5		2.0		2.0
		Aug-99		Aug-99		Aug-99		Aug-99	
		8.0		6.0		12.0		13.0	
		2.5		2.0		3.0		3.5	
			Jul-99		Jul-99		Jul-99		Jun-01
			7.5		8.5		11.0		5.0
			3.0		3.0		3.5		2.5
			MW	Jul-99		Jul-99		Jul-99	
				10.0		13.5		4.0	
				3.1		4.0		2.0	
			Jul-99		Jul-99		Jul-99		Jul-99
			8.0		6.5		10.5		7.0
			3.0		2.5		3.5		2.0
		May-00				Jul-99		Jul-99	
		10.5				8.5		5.5	
		3.0				3.1		2.5	

	Fall 2001	319	West	-Pg 2 of 2											
Row	432	440	448	456	464	472	480	488	496	504	512	520	528	536	544
O		Jul-99		Jul-99		May-00									
		9.0		6.0		10.0									
		3.5		3.5		3.0									
P	Jul-99		Jul-99		Jul-99		Jul-99								
	7.0		10.0		10.5		15.0								
	2.5		3.5		3.5		4.5								
Q		Jul-99		Jul-99		May-00		May-00		Jul-99					
		14.0		8.5		11.5		na		14.0					
		4.0		3.0		4.0				4.0					
R	Jul-99		Jul-99		Jul-99		Jul-99		Jul-99						
	10.5		13.0		10.0		10.0		9.0						
	3.5		4.0		3.0		3.0		2.5						
S		Jul-99		Jul-99		Jul-99		Jul-99		May-00					
		8.0		16.0		7.0		7.0		11.0					
		3.0		5.0		3.0		3.0		3.5					
T	Aug-99		Aug-99		Aug-99		Aug-99		May-00		Aug-99				
	8.0		11.0		10.5		11.5		14.0		14.0				
	3.0		3.5		3.5		3.5		4.0		4.0				
U		Aug-99		Aug-99		Aug-99		Aug-99		May-00		Aug-99			
		15.0		10.0		11.0		13.5		13.5		13.5			
		4.0		3.0		3.0		3.5		3.5		3.5			
V	Aug-99		Jun-01		Aug-99		Aug-99		Aug-99		Aug-99				
	8.0		4.0 R		10.0		15.0		12.0		13.0				
	2.0		1.5		2.5		4.0		3.5		3.5				
W	R	Jul-99		Jul-99		Jul-99	<bad holes>	Jul-99	<bad holes>	Jul-99		May-00			
		8.0		10.5		13.0		13.0		10.5		13.5			
		2.5		3.5		4.5		4.0		3.5		3.5			
X	Jul-99		Jul-99		May-00		Jul-99	mw	Jul-99		May-00		Jul-99		
	9.0		11.0		17.0		10.0		7.0		11.0		13.0		
	3.0		3.5		5.0		3.1		2.5		3.5		3.5		
y		Jul-99		May-00		Jul-99		Jul-99		Jul-99		Jul-99		Jul-99	
		5.0		14.0		10.0		na		8.0		6.0		11.5	
		2.0		4.0		3.1				3.0		2.0		3.5	
Z	Jul-99		Jul-99		Jul-99		Jul-99		Jul-99		Jun-01		Jul-99		Jul-99
	8.0		6.0		9.0		7.0		6.5		naR	naR	5.0		10.0
	2.5		2.5		3.0		2.5		2.5				2.0		3.1
Total Trees															


Fall 2001
319
East
Row
552 560 568 576 584 592 600 608 616 624 632 640 648 656 664
TreeWell Planted
Shallow Planted
Replanted May-00
Replanted Jun-01
Tree Ct
TreeWell
% change from Fall 2000 data
change from Fall 2000 data
TreeWell
TreeWell
O
P
Q
R
S
T
U
V
W
X
y
Z
Average Height Vigor
Total Trees
50 12.7 3.9
74% 5.42 Average Height Increase
33% 0.97 Average Vigor Increase
TreeWell TreeWell